Figure 1: Copper Recycle Unit

INEEL
Idaho National Engineering & Environmental Laboratory
BECHTEL BWXT IDAHO, LLC

Technical Demonstration Summary Sheet

COPPER WIRE RECYCLING TECHNOLOGY

THE NEED

With the increase of Decontamination and Decommissioning activities at nuclear facilities throughout the United States, hundreds of tons of contaminated copper wire are being sent to landfills or temporarily stored until dispositioning is complete. A need exists for reducing the waste volume associated with the disposal of contaminated copper wire. This copper wire recycling technology will separate the copper from the contaminated insulation and dust. The recovered copper wire can then be recycled and reused, thus reducing the final landfill disposal volume and permitting the reuse of this natural resource. This technology is applicable to facility decommissioning projects at Department of Energy (DOE) Nuclear Facilities and Commercial Nuclear Power Plants undergoing decommissioning activities.

THE TECHNOLOGY

NUKEM Nuclear Technologies is the United States licensee of this Copper Recycling Technology. This technology was developed in Stuttgart, Germany, by RADOS. RADOS has used this technology in Europe to successfully recover many tons of contaminated wire for free release and reuse. The Copper Recycle system will process a wide variety of contaminated cables regardless of cable type or size. The cables are pre-sized, placed on a conveyor, and fed into a pre-shredder where the cables are shredded into small pieces that can be more efficiently processed by the grinder. During the grinding process, the copper is separated from the insulation. The processed cable is separated into a clean copper, slightly contaminated insulation and contaminated dust. Contaminated dust generated by the grinding process is filtered through several stages of filtration to prevent the release of airborne contamination. The Copper Recycling process is operated under a negative pressure from the time the wire enters the pre-shredder until it exits the separator. The exhaust air is filtered through a HEPA ventilation system.

THE DEMONSTRATION

The NUKEM Copper Recycling Technology was demonstrated in November, 1999, as part of the INEEL D&D Large Scale Demonstration and Deployment Project (LSDDP) funded by the Department of Energy (DOE) National Energy Technology Laboratory (NETL). This technology demonstration took place at the Bonneville County Technology Center in Idaho Falls, Idaho. Approximately 13.5 tons of non-radioactively contaminated copper wire was recycled for this demonstration. Nearly one-half of the wire was treated with a surrogate contaminant to demonstrate the effectiveness of removing or separating contaminated insulation from the non-contaminated copper wire. Different types of surrogate contamination were used to simulate loose as well as fixed

CONTACTS

- Chelsea Hubbard, Project Manager, U.S. DOE-ID, (208) 526-0645
- Steve Bossart, U.S. DOE, National Energy Technology Laboratory (NETL), DDFA, (304) 285-4643
- Dick Meservey, Project Manager, INEEL (208) 526-1834
- Craig Conner, Test Engineer, INEEL (208) 526-3090
- Russell Ferguson, Test Engineer, INEEL (208) 526-5828
- Stefan Rosenberger, NUKEM Nuclear Technologies, 250 Berryhill Road, Suite 500, Columbia, SC 29210-6465, (803) 214-5860
- George Jobson, NUKEM Nuclear Technologies, 250 Berryhill Road, Suite 500, Columbia, SC 29210-6465, (803) 214-5878

Figure 2: Recycled Copper Wire

contamination, thus allowing analysis and determination of the technology effectiveness. Various sizes and types of wires were selected for the demonstration to show the versatility of the system and to demonstrate its overall throughput with varying wire sizes. During the demonstration wire sizes ranging from telephone wire to large multi-conductor cable were processed. The large cable included high voltage, single-conductor cable with conductor sizes up to 0.75 inches. Large multi-conductor power cables were also processed with individual conductor sizes up to 0.50 inches and having an overall cable diameter of 2.5 inches. Samples of the copper, insulation and dust granules were collected and analyzed during the demonstration to determine the operational as well as the cost effectiveness of this technology.

THE RESULTS

The copper recycling equipment operated very well over a period of approximately five days. A total of 27,100 lbs. of copper wire, in twenty-one 2'x4'x8' waste boxes, was processed. There were 9½, 55-gallon drums (totaling 17,250 lbs.) of clean copper produced during processing with five 2'x4'x8' waste boxes of granular insulation and four 2'x4'x8' waste boxes of dust. The granular insulation can be used as a "void filler" in existing waste boxes further reducing INEEL's final waste volume. Assuming 8 hours of productive time during a 10-hour shift we had a maximum throughput of 6 tons per day or 1,500 lbs. per hour. The average throughput throughout the entire demonstration was 4.4 tons per 8-hour day or 1,100 lbs. per hour, assuming 8 hours of productive time. Of the 27,100 lbs. of wire, approximately 15,000 lbs. was treated with a surrogate contamination. One of the surrogates used to simulate loose contamination was a phosphorescent powder. This substance was applied to the surface of the wire prior to processing. During processing, samples of copper, insulation and dust were collected and examined with a black light. The results showed no phosphorescent powder in the processed copper wire or the insulation granules. A small amount of phosphorescent powder was detected in the dust samples; however, this was to be expected. After the processing of the copper was completed the entire system was examined using a black light. Phosphorescent powder was found on the conveyor, on the entrance to the pre-shedder, the first stage of dust absorbers and in the dust filter bags, all of which are to be expected. Based on the results obtained using the phosphorescent powder surrogate, the copper recycling system appears to have adequately cleaned the simulated contamination from the copper wire. Quantitative results from the laboratory analysis of the other simulated contaminants will be published at a later date in the Innovative Technology Summary Report (ITSR).

BENEFITS

- Recovery of a valuable resource
- Cost reduction in storage and disposal of contaminated wire
- Capability of processing many types and sizes of wire
- Achieved a 80% reduction in final waste volume (assuming insulation is used as "void filler" in other boxes)
- Cost recovery from the sale/re-use of the recovered clean copper

SUMMARY

The Copper Recycling Technology provides an attractive alternative to disposal of radioactively contaminated copper wire. This technology should be considered for all copper recovery projects to reduce cost, waste generation and storage. It is possible that all dust and insulation granules that are waste by-products generated by the recycling process can be used as "void filler" material in existing waste boxes. For example, boxes containing large diameter piping and valves, or radioactively contaminated concrete typically have large void volumes. Based on preliminary evaluations there is a decrease in waste generation as a result of this recycling activity; thus reducing cost and waste volume. Based on cost estimates obtained from local copper recycling vendors, the copper resale value is much higher when processed by the NUKEM Copper Recycling Technology as opposed to non-processed, bulk copper wire.

Figure 3: Cleaned Copper

Figure 4: Insulation Granules

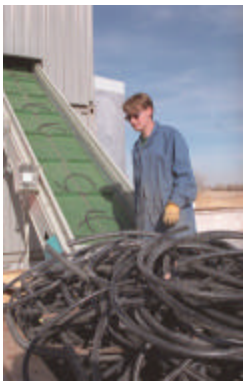

Figure 5: Feeding Copper Wire

Figure 6: Before and After Processing